

ANNMARIE ELDERING

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EDUCATION:

Ph.D., Environmental Engineering Science California Institute of Technology, Pasadena, CA <i>Thesis: Alternative Models for Air Pollutant Effects on Visibility</i> <i>Advisor: Dr. Glen R. Cass</i>	April 1994
M.S., Environmental Engineering Science California Institute of Technology, Pasadena, CA	June 1989
B.E., Chemical Engineering (Summa Cum Laude) Cooper Union for the Advancement of Science and Art, New York, NY	June 1988

EXPERIENCE:

SECTION MANAGER	July 2008 - present
DEPUTY SECTION MANAGER	March 2007 - present
GROUP SUPERVISOR (3283)	May 2006 – Dec 2007
RESEARCH SCIENTIST	August 2002 – May 2006
SCIENTIST	October 1999
Jet Propulsion Laboratory, California Institute of Technology	to July 2002

- Managing Atmospheric Science section
- Deputy PI, Tropospheric Emission Spectrometer on EOS Aura
- Leading new mission concept studies for future atmospheric composition measurements
- Co-lead of team creating advanced mission simulation/OSSE tools
- Lead of SH₂OUT mission concept development for future ESSP call
- Co-lead of Blue Horizon Atmospheric Composition mission design
- Studying tropospheric ozone transport over US with Tropospheric Emission Spectrometer data
- Primary lead on TES cloud algorithm development and validation
- Produced aerosol characterization from ATMOS and MkIV data using custom technique.
- Supported AIRS validation efforts for upper tropospheric water vapor and clouds

ADJUNCT ASSISTANT PROFESSOR and BJERKNES FELLOW University of California, Los Angeles, Atmospheric Sciences	August 1997 to present
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- Developing techniques for remote sensing of aerosols with high spectral resolution data in collaboration with JPL NASA scientists.
- Mentored one student through completion of PhD, currently working on project with 2 others
- Created new upper level undergraduate course 'Air and Water Pollution'.
- Updated graduate level class 'Aerosol, Cloud, and Precipitation Microphysics'.
- Participated in SCOS '97 field study, measuring aerosol size distributions in collaboration with scientists making OH radical measurements.
- Continued collaboration with students since October 1999.

ASSISTANT PROFESSOR University of Iowa, Civil and Environmental Engineering	April 1994 to July 1997
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- Developed an active research program in air pollution and aerosol characterization including field measurements in Idaho, denuder studies, and analysis of visibility trends.

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- Taught a wide variety classes at the undergraduate and graduate level, in air pollution, aerosols, and environmental engineering laboratory techniques.
- Supervised seven graduate students to the completion of Master's degrees.

PUBLICATIONS:

49. Fetzer, E. J., et al. (2008), Comparison of upper tropospheric water vapor observations from the Microwave Limb Sounder and Atmospheric Infrared Sounder, *J. Geophys. Res.*, 113, D22110, doi:10.1029/2008JD010000.
48. Eldering, A. et al (2008) Implementation of cloud retrievals for TES atmospheric retrievals: 2. Characterization of cloud top pressure and effective optical depth retrievals, *J. Geophys. Res.*, 113, D15S37
47. Shephard, M.W et al (2008) Comparison of Tropospheric Emission Spectrometer nadir water vapor retrievals with in situ measurements, *J. Geophys. Res.*, 113, D15S24
46. Osterman, G. et al (2008) Validation of Tropospheric Emission Spectrometer (TES) measurements of the total, stratospheric, and tropospheric column abundance of ozone, *J. Geophys. Res.*, 113, D15S16
45. Beer, R. et al (2008) First satellite observations of lower tropospheric ammonia and methanol, *Geophys. Res. Lett.* 35,L09801, doi:10.1029/2008GL033642.
44. B. H. Kahn, C. K. Liang, A. Eldering, A. Gettelman, Q. Yue, and K. N. Liou, (2008) Tropical thin cirrus and relative humidity observed by the Atmospheric Infrared Sounder, *Atmos. Chem. Phys.*, 8, 1501 - 1518
43. B. H. Kahn, M. T. Chahine, G. L. Stephens, G. G. Mace, R. T. Marchand, Z. Wang, C. D. Barnet, A. Eldering, R. E. Holz, R. E. Kuehn, and D. G. Vane (2008) Cloud type comparisons of AIRS, CloudSat, and CALIPSO cloud height and amount, *Atmos. Chem. Phys.*, 8, 1231–1248
42. Choi, Y., Wang, YH., Yang, Q., Cunnold, D., T., Shim, C., Luo, M., Eldering, A., Bucsela, E., Gleason, J. (2008) Spring to summer northward migration of high O₃ over the western North Atlantic, *Geophys. Res. Lett.*,
41. Luo, M., et al. (2007), TES carbon monoxide validation with DACOM aircraft measurements during INTEX-B 2006, *J. Geophys. Res.*, 112, D24S48, doi:10.1029/2007JD008803.
40. Kalashnikova, O. V., F. P. Mills, A. Eldering, D. Anderson. (2007) Application of satellite and ground-based data to investigate the UV radiative effects of Australian aerosols. *Rem. Sens. Environ.*, 107 (1-2): 65
39. Luo, M. et al. (2007), Comparison of carbon monoxide measurements by TES and MOPITT: Influence of a priori data and instrument characteristics on nadir atmospheric species retrievals, *J. Geophys. Res.*, 112, doi:10.1029/2006JD007663
38. Kahn, B. H., E. Fishbein, S. L. Nasiri, A. Eldering, E. J. Fetzer, M. J. Garay, and S. Lee (2007), The radiative consistency of AIRS and MODIS cloud retrievals, *J. Geophys. Res.*, 112, doi:10.1029/2006JD007486.
37. Kahn, B. H., A. Eldering, A. J. Braverman, E. J. Fetzer, J. H. Jiang, E. Fishbein, and D. L. Wu (2007), Toward the characterization of upper tropospheric clouds using Atmospheric Infrared Sounder and Microwave Limb Sounder observations, *J. Geophys. Res.*, 112, D05202, doi:10.1029/2006JD007336.
36. L. Jourdain, H.M. Worden, J.R. Worden, K. Bowman, Q. Li, A. Eldering, S.S. Kulawik, G. Osterman, F. Boersma, B. Fisher, C.P. Rinsland, R. Beer, M. Gunson, (2007) Tropospheric vertical distribution of tropical Atlantic ozone observed by TES during the Northern African biomass burning season, *Geophys. Res. Lett.*, doi:10.1029/2006GL028284
35. J. Worden, X. Lui, K. Bowman, K. Chance, R. Beer, A. Eldering, M. Gunson, H. Worden (2007), Improved tropospheric ozone profile retrievals using OMI and TES radiances, *Geo. Res. Lett.*, 34, L01809, doi:10.1029/2006GL027806.
34. L. Zhang, D.J. Jacob, K.W. Bowman, et al, (2007) Ozone-CO correlations determined by the TES satellite instrument in continental outflow regions, *Geo. Res. Lett.*, 33 doi:10.1029/2006GL026399.
33. Worden, H. M., et al. (2007), Comparisons of Tropospheric Emission Spectrometer (TES) ozone profiles to ozonesondes: Methods and initial results, *J. Geophys. Res.*, 112, D03309, doi:10.1029/2006JD007258.
32. C.P Rinsland, M. Luo, J.A. Logan et al, (2006) Nadir measurements of carbon dioxide distributions by the Tropospheric Emissions Spectrometer instrument onbaord Aura Spacecraft: Overview of analysis approach and examples of initial results, *Geo. Res. Lett.* 33, doi:10.1029/2006GL027000

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31. I. Folkins, P. Bernath, C. Boone, L. J. Donner, A. Eldering, G. Lesins, R. V. Martin, B.-M. Sinnhuber, and K. Walker (2006), Testing convective parameterizations with tropical measurements of HNO₃, CO, H₂O, and O₃: Implications for the water vapor budget, *J. Geophys. Res.*, 111, D23304, doi:10.1029/2006JD007325.
30. S.S. Kulawik, J. Worden, A. Eldering, K. Bowman, M.R. Gunson, et al., (2006), Implementation of Cloud Retrievals for Tropospheric Emission Spectrometer (TES) Atmospheric Retrievals - part I description and characterization of errors on trace gas retrievals, *J. Geophys. Res.*, 111, D24204, doi:10.1029/2005JD006733
29. J. Worden et al, (2006) TES observations of the tropospheric HDO/H₂O ratio: estimation approach and characterization, *J. Geophys. Res.*, 111, D16309. doi:10.1029/2005JD006606
28. M.C. Lampel et al, (2006) Diagnostics for initial Tropospheric Emissions Spectrometer (TES) Nadir Retrievals, *IEEE Transactions on Geoscience and Remote Sensing*, accepted
27. K.W. Bowman et al, (2006) Tropospheric Emission Spectrometer: Retrieval Method and Error Analysis, *IEEE Transactions on Geoscience and Remote Sensing*, 44, 1297-1307.
26. S.S. Kulawik et al, (2006) TES atmospheric profile retrieval characterization: an orbit of simulated observations, *IEEE Transactions on Geoscience and Remote Sensing*, 1324-1333.
25. S.A. Clough et al, (2006) Forward model and jacobians for Tropospheric Emission Spectrometer retrievals, *IEEE Transactions on Geoscience and Remote Sensing*, 44, 1308-1323
24. E. J. Fetzer, B. Lambrigtsen, A. Eldering, H.H. Aumann, M.T. Chahine (2006) Biases in precipitable water vapor climatologies from AIRS and AMSR-E, *J. Geophys. Res.*, 111, D09S16, doi:10.1029/2005JD006598.
23. A. Gettelman, W.D. Collins, E.J. Fetzer, A. Eldering, F.W. Irion, P.B. Duffy, G. Bala (2006), Climatology of upper tropospheric relative humidity from the Atmospheric Infrared Sounder and implications for climate, *Journal of Climate*, 19, 6104-6121.
22. A. Gettelman, E.J. Fetzer, A. Eldering, F.W. Irion (2006) The global distribution of supersaturation in the upper troposphere from the atmospheric infrared sounder, *Journal of Climate*, 19, 6089-6103.
21. H. M. Steele , A. Eldering, J. Lumpe (2006) Simulations of the accuracy in retrieving stratospheric aerosol effective radius, composition and loading from infrared spectral transmission measurements, *Applied Optics*, 45, 2048-2061
20. B.H. Kahn, K.N. Liou, S.-Y. Lee, E.F. Fishbein, S. DeSouza-Machado, A. Eldering, E.J. Fetzer, S.E. Hanson. L.L. Strow, (2005) Nighttime cirrus detection using Atmospheric Infrared Sounder window channels and total column water vapor, *Journal Of Geophysical Research*, 110, 10.1029/2004JD005430
19. B.H. Kahn, A. Eldering, M. Ghil, S. Bordoni, and S.A. Clough (2004) Sensitivity analysis of cirrus cloud properties from high-resolution infrared spectra. Part I: Methodology and synthetic cirrus. *Journal Of Climate* 17, 4856-4870
18. A. Gettelman, E.M. Weinstock, E.J., Fetzer, F.W. Irion, A. Eldering, E.C. Richard, K. H. Rosenlof, T. L. Thompson, J.V. Pittman, C. R. Webster, and R. L. Herman (2004) Validation of Aqua satellite data in the upper troposphere and lower stratosphere with in situ aircraft instruments, *Geophysical Research Letters* 31, Art. No. L22107
17. A. Eldering, B.H. Kahn, F.P. Mills, F.W. Irion, H.M. Steele, and M.R. Gunson (2004) Vertical profiles of aerosol volume from high spectral resolution infrared transmission measurements: Results, *Journal Of Geophysical Research-Atmospheres* 109, Art. No. D20201
16. A. Braverman, E. Fetzer, A. Eldering, S. Nittel, K. Leung, (2003) Semi-streaming Quantization for Remote Sensing Data, *Journal of Computational and Graphical Statistics*, vol. 2, 759-780.
15. B.H. Kahn, A. Eldering, S.A. Clough, E.J. Fetzer, E. Fishbein, M. R. Gunson, S.Y. Lee, P.F. Lester, V.J. Realmuto (2003) Near micron-sized orographic cirrus cloud particles in high-resolution infrared spectra, *Geophysical Research Letters*, 10.1029/2003GL016909.
14. H.M. Steele, A. Eldering, B. Sen, G.C. Toon, (2003) The retrieval of stratospheric aerosol size and composition information from solar infrared transmission spectra, *Applied Optics* 42, 2140-2154..
13. F.W. Irion, M.R. Gunson, G.C. Toon, A.Y. Chang, A. Eldering, E. Mahieu, G.L. Manney, H.A. Michelsen, E.J. Moyer, M.J. Newchurch, G.B. Osterman, C.P. Rinsland, R.J. Salawitch, B. Sen, Y.L. Yung, and R. Zander, (2002) The Atmospheric Trace Molecule Spectroscopy Experiment (ATMOS) Version 3 data retrievals. *Applied Optics*, 42, 2140-2154.
12. A. Eldering, J.A. Ogren, Z. Chowdhury, L.S. Hughes, and G.R. Cass (2002). Aerosol optical properties during INDOEX based on measured aerosol particle size and composition, *JGR*, 10.1029/2001JD001572

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11. B. H. Kahn, A. Eldering, F. W. Irion, F.P. Mills, B. Sen, and M.R. Gunson (2002). Cloud identification in ATMOS infrared occultation measurements, *Applied Optics*, **41**, 2768-2780.
10. A. Eldering, F. W. Irion, A. Y. Chang, M. R. Gunson, F. W. Mills and H.M. Steele (2001). Vertical profiles of aerosol volume from high spectral resolution infrared transmission measurements: I. Methodology. *Applied Optics*, **40**, 3082-3091.
9. M. J. Kleeman, A. Eldering, and G. R. Cass (2001). Source contributions to visibility reduction in Los Angeles, *Environmental Science and Technology* **35**, 4668-4674.
8. A. Eldering and R. Glasgow (1998). Short term particulate matter mass and aerosol size distribution measurements: Transient pollution episodes and bimodal aerosol mass distributions. *Atmospheric Environment*, **32**, 2017-2024.
7. M. J. Kleeman, G. R. Cass, and A. Eldering (1997). Modeling the airborne particle complex as a source-oriented external mixture. *Journal of Geophysical Research*, **102**, 21355-21372.
6. S. Hering, A. Eldering, and J. H. Seinfeld (1997). Bimodal character of accumulation mode aerosols in Southern California. *Atmospheric Environment*, **31**, 1-11.
5. A. Eldering and G. R. Cass (1996). A source-oriented model for air pollutant effects on visibility. *Journal of Geophysical Research*, **101**, 19343-19369.
4. A. Eldering, J. R. Hall, K. J. Hussey, and G. R. Cass (1996). A visibility model based on satellite-generated landscape data. *Environmental Science and Technology*, **30**, 361-370.
3. A. Eldering, G. R. Cass, and K. C. Moon (1994). An air monitoring network using continuous size distribution monitors: connecting pollutant properties to visibility via Mie scattering calculations. *Atmospheric Environment*, **28**, 2733-2749.
2. A. Eldering, S. M. Larson, J. R. Hall, K. J. Hussey, and G. R. Cass (1993). Development of an improved image processing based visibility model. *Environmental Science and Technology*, **27**, 626-635.
1. A. Eldering, P.A. Solomon, L. G. Salmon, T. Falls, and G. R. Cass (1991). Hydrochloric Acid: A regional perspective on concentrations and formation in the atmosphere of Southern California. *Atmospheric Environment*, **25A**, 2091-2102.

SELECTED GRANTS:

- Remaining Challenges in Atmospheric Chemistry: Quantifying Measurement Requirements for Remote Sensing, PI, NASA Atmospheric Chemistry, 3 year grant, \$550,000, funded April 2007.
- Radiatively Important Thin Cirrus: Characterization from AIRS Observations, JPL-UCLA SURP, \$13,000, January 2007.
- Retrieval of Cirrus Cloud Characteristics from AIRS Observations and Comparisons to UCLA GCM, JPL-UCLA SURP, \$25,000, July 2005.
- Monitoring Volcanic Plumes and Clouds from Terra and Aqua, co-I on NASA 3-yr funded grant with Vince Realmuto
- EOS integrated investigations of upper tropospheric water, clouds and temperature. Co-I on funded 3-yr, 150K, NASA grant with Bill Randel, Andrew Gettleman, and Fredrick Irion. March 2003
- Aerosol and Clouds: Composition Studies Capitalizing on High Spectral Resolution Infrared Measurements, 3 yr grant of \$160,000, NASA Atmospheric Chemistry, Modeling and Analysis Program, March 2003.
- Volume Holographic Filters for Spectroscopic Measurement of Atmospheric Gases, co-Investigator Demetri Psaltis, Caltech, Grant of \$110,000 from the Caltech President's Fund, September 2002
- Characterization of High Clouds from Thermal Infrared Emission Measurements, co-Investigator Kuo Nan Liou, UCLA, Grant of \$80,000 from the Caltech President's Fund, June 2001
- High Resolution Solar Transmission Measurement for the Detection of Aerosols and Clouds. Grant of \$349,587 over three years from NASA New Investigator Program, April 1999.
- Aerosol Remote Sensing: A Study for the Chemistry and Circulation Occultation Spectroscopy Mission, Grant of \$15,000 from NASA through UC Irvine, September, 1998.
- Remote Sensing of Aerosol Characteristics: Combined Ultraviolet/ Visible and Infrared Spectroscopy, co-Investigator Helen Steele, Grant of \$100,000 from the Caltech President's Fund, July 1998.
- An Investigation of the Effects of Uncertainties in Aerosol Mixing on Radiative Forcing Calculations, Seed Grant of \$15,000 awarded by the Center for Global and Regional Environmental Research, University of Iowa, September 1995.

AWARDS:

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- NASA Exceptional Achievement Medal, 2006
- GSFC Group Achievement Award, Aura Team, 2005
- NASA Group Achievement Award, Aura Project, 2005

RECENT PRESENTATIONS:

- Ozone over the Southeast US, Workshop seminar, Penn State, April 2007
- TES: Insights into Global Ozone, Departmental Seminar, Texas A&M, Atmospheric Sciences, April 2007
- TES: Insights into Global Ozone, IGARRS Meeting, August 2006
- New Results and Insights in Tropospheric Composition – TES – Tropospheric Emission Spectrometer, Yuk Yung lunch seminar at Caltech, April 2006
- Remote Sensing and Global Air Pollution: A New View with TES and Other Satellite Instruments, 23rd Informal Symposium on Kinetics and Photochemical Processes in the Atmosphere, February 2006
- TES: Remote Sensing of Tropospheric Trace Gases, Departmental Seminar, Chemistry Department, Fresno State, February 2006
- Air Pollution Investigation Constellation, Community Workshop on Air Quality Remote Sensing from Space Defining an Optimum Observing Strategy, NCAR, Boulder, CO, February 2006
- Global Atmospheric Science Mission Simulation Tool: Section All Hands Meeting, JPL, December 2005
- Global O3 and CO: A View from TES, Presentation at AGU Fall Mtg, San Francisco, Dec 2005
- Remote Sensing: Current Events in Ozone and Water UCLA AS772 seminar, November 2005
- Remote Sensing of Clouds, guest lecture in Geography Depart., CSUN, September 2005
- Simultaneous Cloud and Relative Humidity Measurements: Observations from TES and AIRS, poster at Gordon Research Conference on Radiation and Climate, July 2005
- Temperature, Water Vapor, and Clouds in the Upper Troposphere: Observations from TES and AIRS, Poster at the American Meteorological Society Meeting, June 2005
- SH₂OUT: Sensing of H₂O in the Upper Troposphere, Poster at Solar Occultation Science Team Meeting, June 2005
- Water vapor intercomparisons: TES – AIRS – AMSR, AIRS science team Meeting, May 2005
- AIRS Cloud Products: Comparisons of AIRS visible, AIRS Infrared, ARM and MODIS, poster at AGU Fall Meeting, San Francisco, December 2004
- Upper Tropospheric Water Vapor from AIRS Measurements: Comparisons to ARM and Dedicated Sondes: Poster at AGU Spring Meeting, Montreal, May 2004
- A Quick Look at AIRS UT/LS Data Products, NCAR UT/LS Workshop, October 2003
- Aura Science Team 2003
- Atmospheric Science: Climate, Clouds, and Aerosols: presentation for JPL outreach to museum curators, April 2003
- Using High Spectral-resolution FTIR Measurements to Characterize SSA: Volume, Size, and Composition, Solar Occultation Science Team Meeting, May 2003
- Aerosol Characterization from Infrared Measurements: What can we say about concentration, composition, and size, JPL ACDR seminar March 2003
- Composition of Stratospheric Sulfuric Acid Aerosols Retrieved from ATMOS, Poster at AGU Fall Meeting, San Francisco, December 2002
- Experience and Expectations with ATMOS and TES, given on behalf of Michael Gunson, workshop on future remote sensing needs, Goddard, June 2002
- Cloud and Aerosol Impacts on FTIR Emission Measurements, NASA Workshop on Spectroscopic Needs for Remote Sensing, San Diego, CA, October 2001.
- Clouds, Aerosols, and FTIR Emission Measurements, The 10th International Workshop on Atmospheric Science from Space using Fourier Transform Spectrometry, Ventura, CA, Oct. 2001.
- Stratospheric sulfuric acid aerosols: Composition and temperature discrimination with the ATMOS data set, Fall AGU, San Francisco, CA, Dec 2000.
- Considering the Impact of Aerosols on High Resolution FTS Measurements. The 9th International Workshop on Atmospheric Science from Space using Fourier Transform Spectrometry, Kyoto, Japan, May 2000.
- Vertical Profiles of Stratospheric Sulfuric Acid Aerosols from High Resolution Infrared Measurements. 18th Annual Meeting, American Association for Aerosol Research, October 1999.
- Profiles of Stratospheric Sulfuric Acid Aerosols from High Resolution Infrared Measurements. International Global Atmospheric Chemistry meeting, Bologna, Italy, September 1999.

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- Determination of Stratospheric Sulfate Aerosol Composition and Mass Loading from High Resolution Infrared Transmission Measurements. 1999 European Aerosol Conference, Prague, Czech Republic, September 1999.
- Retrieval of Aerosol Profiles from ATMOS Solar Occultation Measurements. Seminar at Cambridge University to the Atmospheric Chemistry and Modeling Group, March 1999.
- Can We Use Space-borne FTIR Spectroscopy to Measure Aerosols? 16th Annual Photochemistry and Kinetics Symposium, Cal State LA, February 1999.
- Analysis of ATMOS Solar Occultation FTIR Data to Study Aerosols. University of Waterloo, Chemistry Department, February 1999.
- Analysis of ATMOS Solar Occultation FTIR Data to Study Aerosols. Jet Propulsion Laboratory, Atmospheric Chemistry Division Seminar, January 1999.
- Analysis of ATMOS Solar Occultation FTIR Data to Study Aerosols and Clouds. 1998 Fall Meeting, American Geophysical Union, Poster presentation, December 1998.
- Retrieval of Aerosols and Cloud Profiles from ATMOS Solar Occultation Measurements. 17th Annual Meeting, American Association for Aerosol Research, June 1998.
- Combined IR and UV/vis Measurements of Aerosols. UC Berkeley Civil and Environmental Engineering Department, March 1998.